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In situ Characterization of delta-Bi_2O_3 Stabilized by Epitaxial Growth on Single Crystal Oxide Substrates

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The cubic phase of Bi_2O_3, delta-Bi_2O_3, has the largest ionic conductivity of any oxide material, but is stable only from 725°C to 825°C. We observe that the delta-Bi_2O_3 phase is stabilized to room temperature by the epitaxial growth of nanostructures onto either (001)-oriented $SrTiO_3$ or (001) pseudo-cubic-oriented $DyScO_3$ single-crystal substrates. The morphology of the nanostructures can be controlled by the miscut of the substrate. Synchrotron x-ray scattering observations at controlled temperatures and oxygen partial pressures reveal that the delta-Bi_2O_3 nanostructures are coherently strained to the substrates at room temperature, but have an unexpected superstructure. Annealing the nanostructures at 600°C causes gradual conversion of the (001)-oriented delta phase to an unidentified strain-relaxed phase. Recent experiments have shown that the delta phase can also be stabilized by the growth of epitaxial thin films on (111) Y_2O_3-stabilized ZrO_2 and (0001) alpha-Al_2O_3. Future work will combine the structural characterization of thin films with *in situ* electrical measurements to determine the source of the observed superstructure and give insight into the origin of the high ionic conductivity of delta-Bi_2O_3. This work will contribute to the fundamental understanding of the origin of superionic conductivity in oxide materials.